Clumpy molecular structures revolving the B[e] supergiant MWC 137

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Abstract. The peculiar emission-line star MWC 137 with its extended optical nebula was recently classified as B[e] supergiant. To study the spatial distribution of its circumstellar molecular gas on small and large scales, we obtained near-infrared and radio observations using SINFONI and APEX, respectively. We find that the hot CO gas is arranged in moving clumpy ring and shell structures close to the star, while a cold CO envelope is encircling the borders of the optical nebula from the south to the west.

1. Introduction

The Galactic object MWC 137 is a peculiar early-type star surrounded by the optical nebula Sh 2-266 ($80'' \times 60''$) of unclear origin. A large-scale collimated outflow with several knots was recently detected in the light of the [N II] 6583 line (Mehner et al. 2016). Moreover, near-infrared spectroscopic observations displayed intense, kinematically broadened CO band emission in both isotopes ^{12}CO and ^{13}CO (Oksala et al. 2013). The observed enrichment in ^{13}CO implies that MWC 137 is an evolved object (Muratore et al. 2015), and Mehner et al. (2016) confirmed its supergiant nature.

2. Observations and Results

We obtained SINFONI *K*-band IFU spectroscopic data of MWC 137 on 2014 December 30 and 2016 March 19 with high-spatial resolution (FOV of $0.8'' \times 0.8''$). The continuum subtracted hot CO band images (Fig. 1, left) display an outer ring (shell?) with $r_{\rm out}$ = 225 mas (dashed circle) and an inner disk or ring (ellipse) with two large blobs (pointed at by the arrows). The major and minor semiaxes are 112.5 mas and

97.5 mas, resulting in an inclination of $\sim 30°$. These were determined by the position of the maximum intensity of the blobs and the constraint that the disk should be roughly perpendicular to the optical jet. The two blobs show an angular motion of $\sim 10°$ within 15 months. This would translate into $v_{\rm rot} = 375\,{\rm km\,s^{-1}}$, if we assume a distance of 5.2 kpc, which is too fast for Keplerian rotation.

Observations of the ^{12}CO(3-2) line at 345 GHz were obtained with the Atacama Pathfinder EXperiment (APEX) in a region of $3' \times 3'$ centered on Sh2-266, with an angular resolution of $20''$. The cold CO emission comprises a partial shell in the velocity interval $[+27.3,+30.3]\,{\rm km\,s^{-1}}$ (contours in Fig. 1, right). According to circular galactic rotation models and the velocity field of the Galaxy by Brand & Blitz (1993), gas at these velocities is located at kinematical distances $d = 5 - 9$ kpc, in good agreement with the estimates of Mehner et al. (2016).

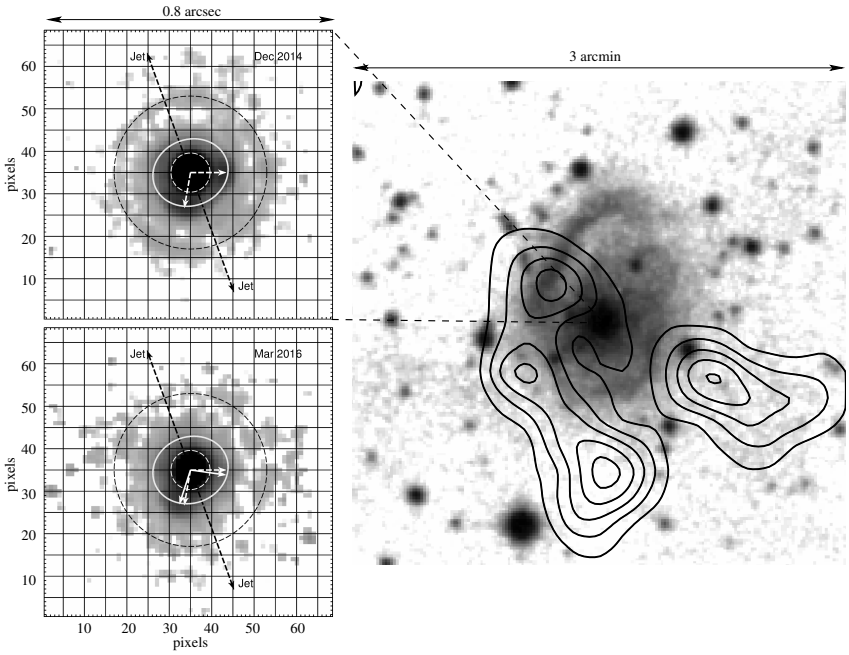

Figure 1. Location and variation of the hot, small-scale (left) and the cold, large-scale (right, contours) CO emission with respect to the jet and the optical nebula.

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